

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference UB-11456 DE	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/SE 00/01416	International filing date (<i>day/month/year</i>) 4 July 2000	(Earliest) Priority Date (<i>day/month/year</i>) 5 July 1999
Applicant SANDVIK AB; (publ) et al		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Certain claims were found unsearchable (See Box I).
2. Unity of invention is lacking (See Box II).
3. The international application contains disclosure of a nucleotide and/or amino acid sequence listing and the international search was carried out on the basis of the sequence listing
 - filed with the international application.
 - furnished by the applicant separately from the international application,
 - but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.
 - transcribed by this Authority.
4. With regard to the title, the text is approved as submitted by the applicant.
 - the text has been established by this Authority to read as follows:
5. With regard to the abstract,
 - the text is approved as submitted by the applicant.
 - the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.
6. The figure of the drawings to be published with the abstract is:
 - Figure No. 2 as suggested by the applicant.
 - because the applicant failed to suggest a figure.
 - because this figure better characterizes the invention.

None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 00/01416

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: C23C 14/60

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: C23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EDOC,WPI,PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5576058 A (TOR NORRGRANN ET AL), 19 November 1996 (19.11.96), abstract --	1-3
A	US 5667343 A (INGEMAR HESSMAN ET AL), 16 Sept 1997 (16.09.97), figure 1, abstract --	1-3
A	JP 4000372 A (NIPPON STEEL CORP) 1992-01-06 (abstract) World Patents Index (online). London, U.K.: Derwent Publications, Ltd. (retrieved on 2000-10-17). Retrieved from: EPO PAJ Database. DW 199207, Accession No. 1992-053832 & JP 4000372 A (NIPPON STEEL CORP) 1992-04-08 (abstract) (online) (retrieved on 2000-10-17). Retrieved from: EPO PAJ Database. --	1-3

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

19 -10- 2000

17 October 2000

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
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Telephone No. + 46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/01416

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 19821019 A1 (LEYBOLD SYSTEMS GMBH), 18 November 1999 (18.11.99), figure 3, abstract -- -----	1-3

INTERNATIONAL SEARCH REPORT

Information on patent family members

03/10/00

International application No.

PCT/SE 00/01416

Patent document cited in search report		Publication date	Patent family member(s)		Publication date	
US	5576058	A	19/11/96	AT AU AU DE DE EP SE EP SE FI GR IL JP JP NO RU SE SE US US WO	169692 T 667789 B 8069394 A 69415960 D,T 69504045 D,T 0676969 A,B 0676969 T3 0750688 A,B 0750688 T3 953191 A 3029613 T 113015 A 8503160 T 9510507 T 952591 A 2120808 C 509984 C 9400950 A 5728075 A 5759621 A 9525829 A	15/08/98 04/04/96 22/05/95 10/06/99 10/12/98 18/10/95 02/01/97 28/06/95 30/06/99 16/08/98 09/04/96 21/10/97 19/07/95 27/10/98 29/03/99 19/09/95 17/03/98 02/06/98 28/09/95
US	5667343	A	16/09/97	AT AU AU BR CA CN CN DE EP SE ES FI JP NO NO PL PL RU SE SE SE WO	166012 T 680889 B 6389094 A 9406588 A 2156270 A 1046228 B 1119420 A 69410252 D,T 0689489 A,B 0689489 T3 2118395 T 954361 A 8507725 T 301810 B 953663 A 174518 B 310654 A 2111092 C 501915 C 9300888 A 9421411 A 511728 C 9400245 A 5535745 A	15/05/98 14/08/97 11/10/94 02/01/96 29/09/94 10/11/99 27/03/96 10/09/98 03/01/96 16/09/98 15/09/95 20/08/96 15/12/97 15/09/95 31/08/98 27/12/95 20/05/98 19/06/95 19/09/94 29/09/94 15/11/99 28/07/95 16/07/96
DE	19821019	A1	18/11/99	NONE		

PATENT COOPERATION TREATY
PCT
INTERNATIONAL PRELIMINARY EXAMINATION REPORT

REC'D 31 OCT 2001
 PCT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference UB-11456 DE	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/SE00/01416	International filing date (<i>day/month/year</i>) 04.07.2000	Priority date (<i>day/month/year</i>) 05.07.1999
International Patent Classification (IPC) or national classification and IPC7 C23C 14/50		
Applicant SANDVIK AB (publ) et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of _____ sheets.

3. This report contains indications relating to the following items:

- I Basis of the report
- II Priority
- III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV Lack of unity of invention
- V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI Certain documents cited
- VII Certain defects in the international application
- VIII Certain observations on the international application

Date of submission of the demand 31.01.2001	Date of completion of this report 25.10.2001
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Authorized officer Lars Ekeberg/js Telephone No. 08-782 25 00

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/SE00/01416

I. Basis of the report1. With regard to the **elements** of the international application:* the international application as originally filed the description:

pages _____, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

 the claims:

pages _____, as originally filed

pages _____, as amended (together with any statement) under article 19

pages _____, filed with the demand

pages _____, filed with the letter of _____

 the drawings:

pages _____, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

 the sequence listing part of the description:

pages _____, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

 the language of a translation furnished for the purposes of international search (under Rule 23.1(b)). the language of publication of the international application (under Rule 48.3(b)). the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing: contained in the international application in written form. filed together with the international application in computer readable form. furnished subsequently to this Authority in written form. furnished subsequently to this Authority in computer readable form. The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished. The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4. The amendments have resulted in the cancellation of: the description, pages _____ the claims, Nos. _____ the drawings, sheet/fig _____5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/SE00/01416

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims <u>1-3</u>	YES
	Claims _____	NO
Inventive step (IS)	Claims <u>1-3</u>	YES
	Claims _____	NO
Industrial applicability (IA)	Claims <u>1-3</u>	YES
	Claims _____	NO

2. Citations and explanations (Rule 70.7)

Cited documents:

1. US 5576058 A (Tor Norrgrann et al.)
2. US 5667343 A (Ingemar Hessman et al.)
3. JP 4000372 A (Nippon steel corp.)
4. DE 19821019 A1 (Leybold system gmbh)

The documents cited in the International Search Report represent background art.

The invention defined in claims 1-3 is not disclosed by any of these documents.

None of the cited documents gives any indication towards the claimed method of fixturing cutting tool inserts in a PVD coating equipment. No relevant combination of the cited documents would lead a person skilled in the art to the invention defined in the claims.

Therefore, the invention defined in claims 1-3 is novel and is considered to involve an inventive step. It is also considered to be industrially applicable.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
11 January 2001 (11.01.2001)

PCT

(10) International Publication Number
WO 01/02620 A1

(51) International Patent Classification⁷: C23C 14/60

Tor [SE/SE]; Dalkarlsvägen 27, S-141 40 Huddinge (SE).
HESSMAN, Ingemar [SE/SE]; Silverslingan 19, S-811
52 Sandviken (SE).

(21) International Application Number: PCT/SE00/01416

(74) Agent: TÅQUIST, Lennart; Sandvik AB, Patent Dept.,
S-811 81 Sandviken (SE).

(22) International Filing Date: 4 July 2000 (04.07.2000)

(81) Designated States (national): IL, JP, US.

(25) Filing Language: English

(84) Designated States (regional): European patent (AT, BE,
CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC,
NL, PT, SE).

(26) Publication Language: English

Published:

(30) Priority Data:
9902574-4 5 July 1999 (05.07.1999) SE

— With international search report.

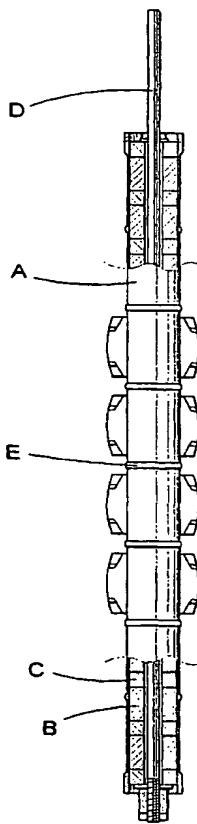
(71) Applicant (for all designated States except US): SAND-
VIK AB; (publ) [SE/SE]; S-811 81 Sandviken (SE).

For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(72) Inventors; and
(75) Inventors/Applicants (for US only): NORRGRANN,

(54) Title: LOADING SYSTEM FOR PVD COATING OF CUTTING INSERTS

(57) Abstract: The present invention relates to a method of fixturing cutting tool inserts in a PVD (Physical Vapor Deposition) coating equipment. The method consists in using a tube manufactured of a non-magnetic metallic material surrounding a stack of alternating discs of a magnetic material and iron. The north poles of the magnets are directed towards each other and the cutting inserts are positioned on the outer wall of the solid tube and kept in place by the magnetic forces.



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2 | PRTS 1

LOADING SYSTEM FOR PVD COATING OF CUTTING INSERTS

BACKGROUND OF THE INVENTION

The present invention relates to a PVD (Physical Vapour Deposition) batch fixturing system for cutting inserts, suitable for rational large scale production and allowing for fully automatic loading.

Physical Vapour Deposition of wear resistant hard coatings on cemented carbide cutting inserts has been in industrial use for more than 15 years and the practice of the PVD method is still increasing as is the number and variety of products subjected to this process.

The PVD process is, in contrast to CVD (Chemical Vapour Deposition), a line-of-sight process with limited ability to achieve an equal coating thickness around a three-dimensional body such as a cutting insert. This fact requires special arrangements for the fixturing system; the cutting edges of the individual cemented carbide cutting insert as well as the cutting edges of all the inserts in the entire batch must be as equally exposed to the flux of the coating material as possible. Preferably, the largest coating thickness is to be found on that part of the insert where it is most required for the particular cutting operation to be carried out. Furthermore, the rake face and the clearance face of the insert must both be subjected to the least possible effect of shadowing from the surrounding cutting inserts. These requirements may lead to a low loading density of inserts if not specifically designed loading fixtures are being used. A further complication is introduced when the cutting inserts do not possess any holes in the centre enabling hanging them on an arrangement of hooks.

There are several methods for loading inserts without holes available but two main principles can be distinguished:

(i) locking the inserts in mechanical fixtures and keeping them in a desired position through e.g. slits or arms

5 (ii) fixturing the inserts on magnetic holders allowing for the magnetic forces to keep the inserts in a fixed position during the deposition process.

The limitation of method (i), mechanically locking the inserts in fixed positions, is the risk that the locking device itself will shadow an area of the insert
10 that should be coated. The shadowing effect may cause an undesired variation in the coating thickness or, in the worst case, areas that are almost without a coating. It is a disadvantage in cutting operations if the areas with thinner or absent coatings are located within the
15 depth-of-cut area on the insert tool edge. The cosmetic appearance of the insert may also become undesirable with marks and fluctuations in colour that are not the same and alike on all the inserts.

The limitation of method (ii), magnetic holders, is
20 the weight of the magnets which is significant. The high weight of the magnet assembly will restrict the functionality of the mechanism used to rotate the batch in the PVD coating chamber. The rotation is required in order to achieve as equal coating conditions as possible
25 on all the material in the batch. The area of the insert, which is in contact with the magnet, will inevitably remain without a coating restricting the method to be best suited for inserts that may be allowed to have one side or one part of a side without a coating. Furthermore, one requirement of the inserts' geometrical
30 shape would be that of a flat bottom surface to obtain a large enough contact area to the magnet in order to maximize the magnetic force keeping the inserts in place. The magnetic field strength decreases with increasing temperature and the typical PVD substrate tem-

perature range of 450-500°C, also puts specific requirements on the type of magnets that are to be used for this purpose.

A common practice in the prior art is to fixture 5 the inserts side by side on a four- or six-folded pole. Each side of the pole having an area that allows several inserts to be placed in a two-dimensional pattern. This results in an unfavourable coating thickness distribution. As a consequence of the rotation of the pole, the 10 clearance faces of the inserts placed along the vertical border of a face of the pole, will obtain thicker coatings than all the other clearance faces of the inserts placed on the same side of the pole. Furthermore, the parallel positioning of the inserts will cause a shadowing effect on the clearance faces of the inserts, causing 15 a difference in coating thickness between the rake and clearance faces of the inserts. This difference is in certain cases most undesired in cutting operations.

20 OBJECTS AND SUMMARY OF THE INVENTION

It is an object of this invention to provide a fixture system, especially suited for cutting inserts of a specific geometrical shape, of magnetic holders avoiding or alleviating the general limitations of a loading system 25 based on the magnetic principle. Furthermore, it is an object of the invention to provide a loading system suitable for a rational production in larger scale.

BRIEF DESCRIPTION OF THE DRAWINGS

30 Fig. 1 shows a picture of the presently claimed invention.

Fig. 2 shows a schematic drawing of the presently claimed invention. The invention includes a metallic tube (A) encompassing a stack of alternating discs of 35 magnets (B) and iron cores (C). A bar (D) passes through the centre of the magnets and iron cores. The bar is

adapted to conform to the rotating construction in the PVD-equipment. The tube is further equipped with reinforcement rings (E).

Fig 3 and 4 display cross-sections of the invented construction with cemented carbide inserts loaded in with different loading densities.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

10 The batch loading system according to the present invention utilizes a tube manufactured of a non-magnetic metallic material, surrounding a stack of alternating discs of magnets and iron discs. The cutting inserts are placed on the outer wall of the solid tube and kept in
15 place by the magnetic forces.

20 The physical shape of the outer tube in the present invention may be designed in a number of geometrical shapes. The cross-section of the tube may for instance be circular, elliptical, rectangular, quadratic, pentagonal, hexagonal and so on. In the description of the present invention only the circular cross-section will be described.

25 The circular shape of the fixture makes it specifically suited for loading inserts with a specific geometrical shape. The part of the insert in contact with the tube should preferably have an elongated geometry. One type of inserts that does not posses any central hole and has an elongated bottom surface that is not used in the cutting operation, and which requires an even coating thickness on the rake and the clearance faces, are
30 inserts used for machining operations called parting and grooving. Inserts of this type and other types of inserts with similar qualities are especially suited for the present invention.

35 Fig. 3-4 show that the cylindrical shape of the tube leads to an improved exposure of the clearance

faces in comparison to the inserts being positioned in parallel on a flat surface. The elongated bottom profile of the insert assures a firm contact with the tube. The tubular shape optimizes the ratio between surface area 5 available for loading and volume of magnetic material. Thus, the weight of the fixture is minimized at the same time as the surface area of the fixture is maximized and a high loading density of inserts is allowed.

The arrangement of the magnets is important to the 10 functionality of the loading system. The magnets are orientated with the north poles towards each other. In this way the magnetic field in the iron disc will be amplified and the effect of the magnets is used in an optimal way. The thickness of the magnetic discs in com- 15 parison with the thickness of the iron discs is also of importance. The iron disc must be thick enough to act as a buffer between the magnetic fields from the surrounding magnetic discs and thick enough to avoid saturation in magnetic flux. At the same time the iron disc has to 20 be thin enough to avoid self-demagnetisation of the mag- nets.

The type of magnetic material being used is criti- 25 cal since many of the magnetic materials loose their magnetic properties at elevated temperatures. The mate- rial in the iron discs is preferably an iron material with a low content of alloying elements.

The metallic tube should be manufactured of a non- 30 magnetic material, such as for instance stainless steel, in order not to disturb the magnetic flux from the mag- netic discs to iron discs. The function of the metallic tube surrounding the magnets is primarily to protect the magnets from physical damage and from being coated. A coated surface will after a number of exposures to the coating process begin to loose particles of the coating. 35 These particles will to a certain extent become attached

to the inserts being coated at the time and will form defects on these inserts. Such defects may be detrimental to the performance properties of the insert if the defects are located in an area of the cutting edge being used during the cutting operation. The protective tube is easily removed after a number of deposition cycles and replaced with a new one or, if desired, the tube might be subjected to a cleaning operation such as blasting.

10 The metallic tube, however, will attenuate the magnetic field. In a preferred embodiment, the thickness of the tube is reduced to less than 1.5 mm, preferably less than 1.0 mm.

15 The present invention is suitable for automatic loading of the inserts on the tube. In a preferred embodiment the tube is equipped with reinforcement rings, protruding some tenths of a mm from the outer surface of the tube, at intervals along the vertical axis. This is a precaution in order to also allow for a somewhat harsh treatment of the tube during loading and unloading. The objective of the enhancements is to prevent the inserts 20 from slipping down the tube.

In the foregoing description of the invention only very few specific details have been given. The reason 25 hereto is that the exact conditions and optimal dimensions of the details encompassed in the invention will to a certain extent depend on the design of the coating equipment and deposition conditions used. It is within the purview of the skilled artisan to adapt the method 30 of the present invention with regard to the design and deposition conditions used in the specific equipment.

CLAIMS

1. A method of fixturing cutting tool inserts in a PVD (Physical Vapor Deposition) coating equipment characterized in using a tube manufactured of a non-magnetic metallic material surrounding a stack of alternating discs of a magnetic material and iron where the north poles of the magnets are directed towards each other and the cutting inserts are positioned on the outer wall of the solid tube and kept in place by the magnetic forces.
10
2. A method according to claim 1 characterized in that the cross-section of the tube is circular.
3. A method according to claim 1
15 characterized in that the thickness of the tube wall is less than 1.5 mm, preferably less than 1.0 mm.

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1/1

Fig. 1

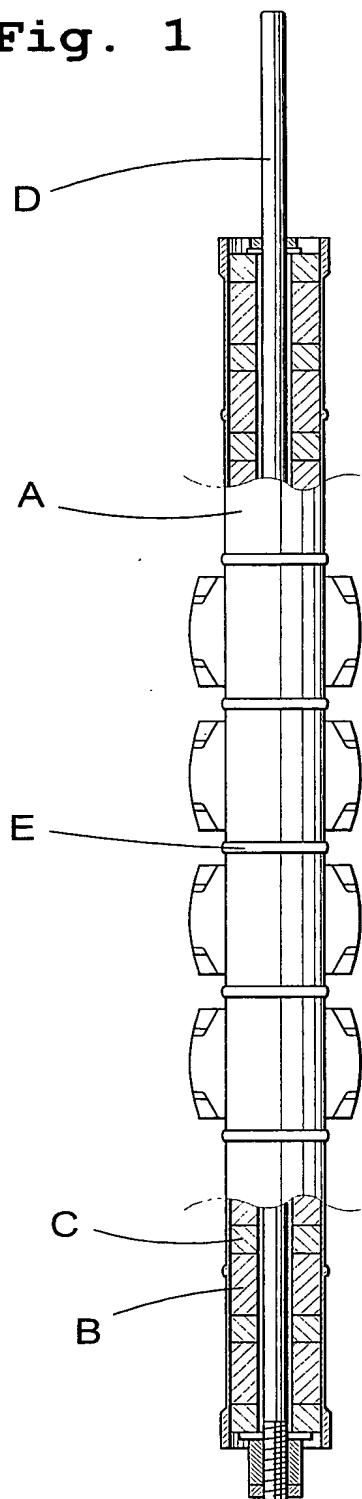


Fig. 2

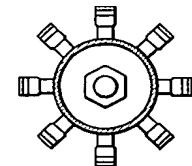
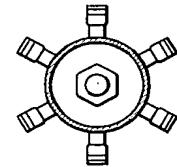


Fig. 3



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2/2

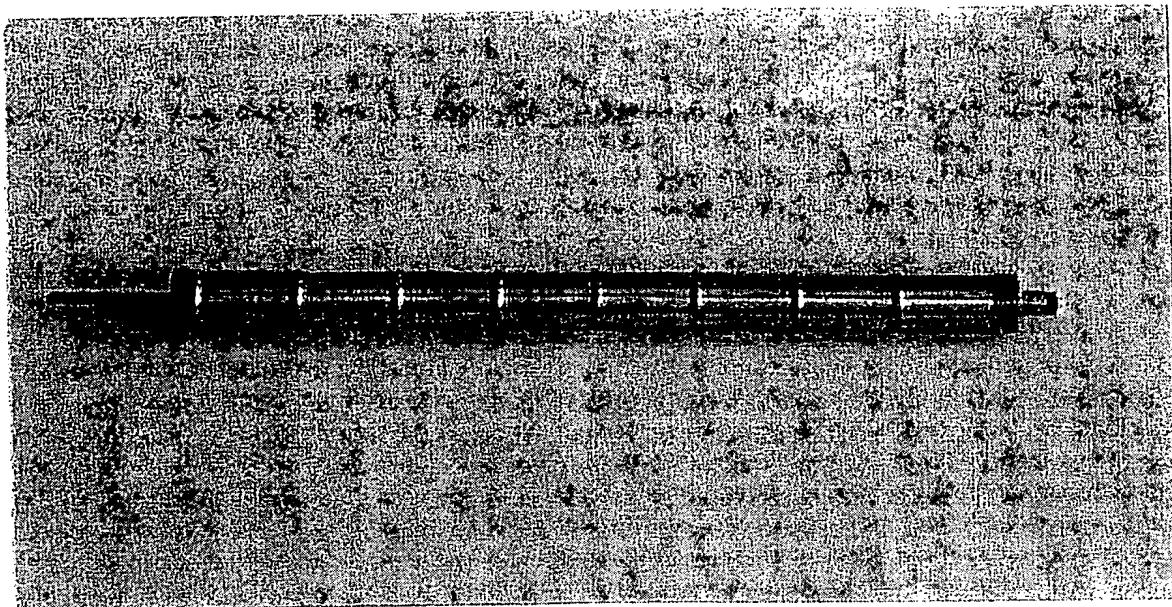


Fig. 1

REVISED VERSION

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
11 January 2001 (11.01.2001)

PCT

(10) International Publication Number
WO 01/02620 A1

(51) International Patent Classification⁷: C23C 14/50 HESSMAN, Ingemar [SE/SE]; Silverslingan 19, S-811 52 Sandviken (SE).

(21) International Application Number: PCT/SE00/01416 (74) Agent: TÅQUIST, Lennart; Sandvik AB, Patent Dept., S-811 81 Sandviken (SE).

(22) International Filing Date: 4 July 2000 (04.07.2000)

(25) Filing Language: English (81) Designated States (*national*): IL, JP, US.

(26) Publication Language: English (84) Designated States (*regional*): European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

(30) Priority Data:
9902574-4 5 July 1999 (05.07.1999) SE Published:
— With international search report.

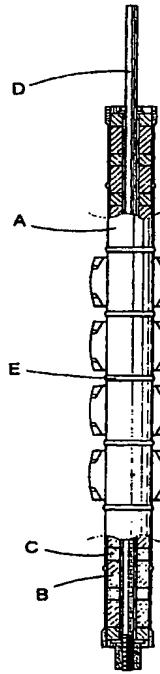
(71) Applicant (*for all designated States except US*): SANDVIK AB; (publ) [SE/SE]; S-811 81 Sandviken (SE). (88) Date of publication of the revised international search report: 7 June 2001

(72) Inventors; and (15) Information about Correction:
— see PCT Gazette No. 23/2001 of 7 June 2001, Section II

(75) Inventors/Applicants (*for US only*): NORRGRANN, Tor [SE/SE]; Dalkarlvägen 27, S-141 40 Huddinge (SE).

[Continued on next page]

(54) Title: LOADING SYSTEM FOR PVD COATING OF CUTTING INSERTS



WO 01/02620 A1

(57) Abstract: The present invention relates to a method of fixturing cutting tool inserts in a PVD (Physical Vapor Deposition) coating equipment. The method consists in using a tube manufactured of a non-magnetic metallic material surrounding a stack of alternating discs of a magnetic material and iron. The north poles of the magnets are directed towards each other and the cutting inserts are positioned on the outer wall of the solid tube and kept in place by the magnetic forces.

WO 01/02620 A1



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: C23C 14/50

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: C23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EDOC,WPI,PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5576058 A (TOR NORRGRANN ET AL), 19 November 1996 (19.11.96), abstract --	1-3
A	US 5667343 A (INGEMAR HESSMAN ET AL), 16 Sept 1997 (16.09.97), figure 1, abstract --	1-3
A	JP 4000372 A (NIPPON STEEL CORP) 1992-01-06 (abstract) World Patents Index (online). London, U.K.: Derwent Publications, Ltd. (retrieved on 2000-10-17). Retrieved from: EPO PAJ Database. DW 199207, Accession No. 1992-053832 & JP 4000372 A (NIPPON STEEL CORP) 1992-04-08 (abstract) (online) (retrieved on 2000-10-17). Retrieved from: EPO PAJ Database. --	1-3

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/EP 00/01416

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